S1l

Improvement of the photochemical oxidant forecast by JMA in 2015

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JMA started the operation of a regional chemistry transport model (NHM-Chem) for its photochemical oxidant forecasts in March 2015 (topic 1).
QC method for in-situ surface O_3 concentration observation was developed in preparation for a planned operational nudging to be applied in 2016 (topic 2).

1. JMA starts operation of NHM-Chem

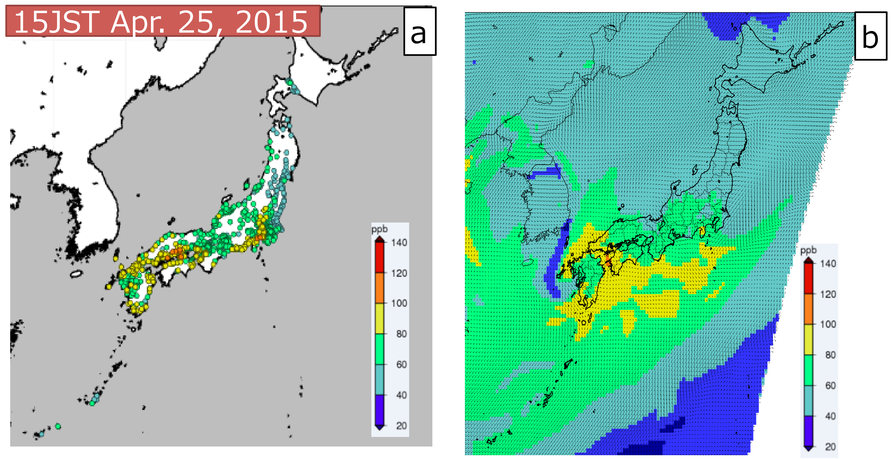

Fig.1 Surface ozone (O_3) concentration (a) observed by local governments and (b) simulated by JMA.

The level of guidance statistically made of simulated surface ozone (O_3) concentration in this case was equivalent to that of observed at 60% of all the prefectures with initial time of previous day, better than of 2 and 3 days ago.

Table 1 Oxidant (Ox) advisory in JMA.

Advisory	Daily Maximum
2	over 120 ppb
1	over 80 ppb
0	below 80 ppb

Table 2 Ratio by magnitude of guidance (GD) compared with that of observed.

Initial time (12UTC)	GD >Obs	GD =Obs	GD <Obs
22 Apr.	55%	40%	4%
23 Apr.	32%	55%	13%
24 Apr.	34%	60%	6%

Table 3 Specifications of a regional chemistry transport model NHM-Chem.

Basic equations	Eulerian model coupled with the regional Non-hydrostatic Mesoscale Model
Numerical technique	Eulerian transport and chemical reaction
Projection and grid size	Lambert conformal conic projection, 20 km
Integration domain	East Asia, 210 × 150 grid points
Vertical levels	18 (surface – 10 km)
Initial time and forecast time	72 hours from 12 UTC (once a day)
Emission inventories	REAS (for East-Asia)
Meteorological fields	JMA-NHM outputs constrained and initialized by the Global Analysis (GA) and forecasts of the Global Spectral Model (GSM)

2. QC method developed for NHM-Chem data assimilation

Table 4 QC methods and their discrepancy ratios.

	Method	Ratio=(B+C)/Total
NoQC	near-real time data without QC1~5	9.68%
QC1	gross check	6.64%
QC2	spatial check	8.32%
QC3	hourly difference check	6.65%
QC4	combination of QC1, 2, 3	3.05%
QC5	more strict check for samples over 100 ppb than QC4	**2.62%**

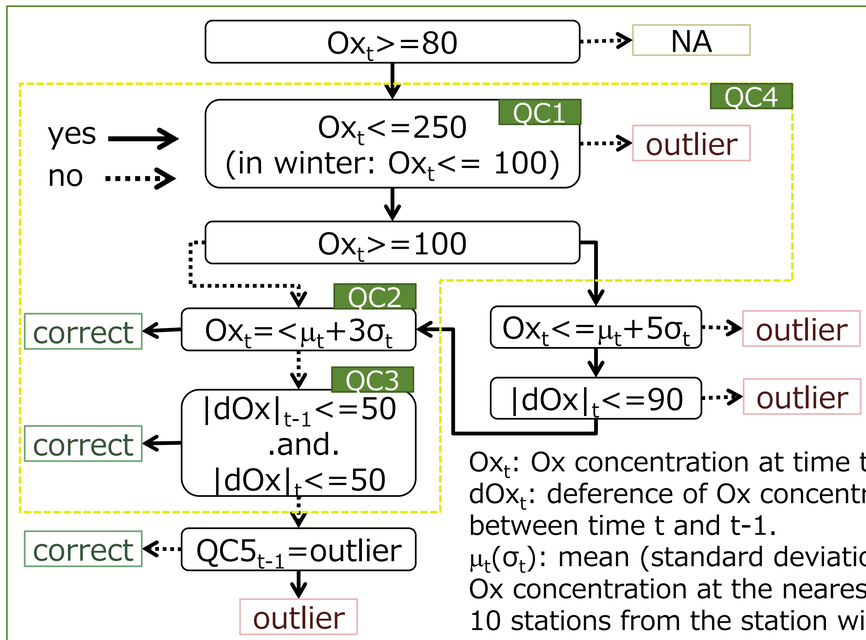

Fig. 2 flowchart of QC5 method.

Ox_t: Ox concentration at time t.
dOx_t: deference of Ox concentration between time t and t-1.
$\mu_t(\sigma_t)$: mean (standard deviation) of Ox concentration at the nearest 6 ~ 10 stations from the station within its 50 km radius at time t.
$QC5_t$: result (outlier or correct) of QC5 at time t.
winter: NOV. – FEB.

JMA can use near-real time (NRT) data; however, as to final results after data screening by local governments (FINAL), JMA can use them about 2 years later. Therefore we developed quality control (QC) methods for NRT data.
We compared NRT data after several QC methods (Table 4, Fig. 2) at 1191 stations from April 2010 to March 2013 with FINAL.
4423 samples were selected as follows:

- observed in 12-18UTC (21-03 local time),
- over 80 ppb,
- equal to FINAL data.

We classified outliers and others in every QC and FINAL as described in Table 5. Discrepancy rate of QC5 was best (Table 4). As result, we determined QC5 for data assimilation with NHM-Chem. QC5 identified whether observed surface O_3 concentration at a station is different from that at stations around it (Fig. 3a, 3b, 4).

Table 5 Number of correct and outlier data in QC5 and FINAL.

		FINAL	
		correct	outlier
QC5	correct	3889(A)	48(B)
	outlier	68(C)	418(D)

3. In the future

- Operate NHM-Chem with data assimaltion.
  - ✓ Validate simulation with in-situ data
  - ✓ Apply QC to NO_x
- Improve spatial resolution of NHM-Chem from 20 km to 5 km.

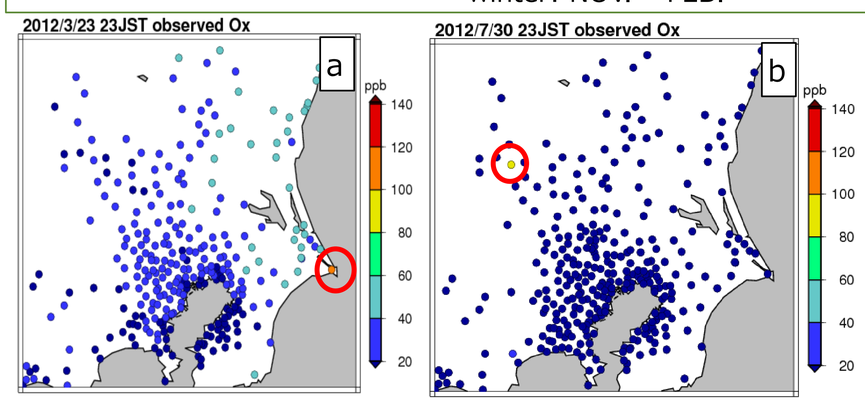

Fig.3 A dot in red circle identified as outlier by QC5 (a, b)

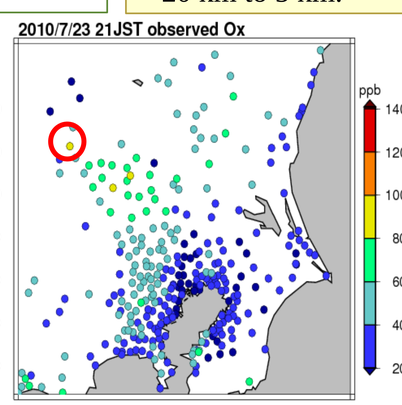

Fig.4 Same as Fig.3a, 3b but identified as correct.

Reference

Kajino, M., Inomata, Y., Sato, K., Ueda, H., Han, Z., An, J., Katata, G., Deushi, M., Maki, T., Oshima, N., Kurokawa, J., Ohara, T., Takami, A., and Hatakeyama, S.: Development of the RAQM2 aerosol chemical transport model and predictions of the Northeast Asian aerosol mass, size, chemistry, and mixing type, Atmos. Chem. Phys., 12, 11833-11856, doi:10.5194/acp-12-11833-2012, 2012.